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Extended Range Less Lethal Stand-Off Capabilities: A 66mm Stingball Grenade

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ABSTRACT

A deficiency has been identified in the ability for U.S. soldiers, in the role of peacekeepers, to keep unarmed combatants at a safe stand-off distance. While these individuals may be unarmed, the threat that they pose steadily increases as their distance decreases. The ability to maintain a "safe-zone" or stand-off distance in a less lethal manner is the intended outcome. In order to accomplish this task, a method to move and or rout these individuals, while promoting area denial, is needed. This paper presents a less lethal, extended range stand-off using existing materials and weapon platforms. Materials were obtained from the L8 Smoke Grenade and used to test a 66mm Stingball and or an Aerial Distraction Device. This 66mm stingball consists of a five and a half inch rubber body that contains rubber balls and an explosive charge tube. Upon detonation, the rubber body splits and the rubber balls are dispersed in roughly a 360° pattern. The sound report of this explosion is sufficient to be classified as a distraction device. This combined effect is a useful tool in dispersing crowds in a less lethal manner while providing the stand-off needed to ensure the safety of the soldiers, and in doings so, the safety of the combatants as well.

INTRODUCTION

The need for an extended range less lethal standoff capability has prompted research into the design of a 66mm Stingball Grenade. Defense Technology Corporation was awarded funding in the amount of $52,400.00 through the Battelle Scientific Services Program, Task Number 97-138. The purpose was to determine the feasibility of developing a less lethal stand-off munition utilizing the existing 66mm launch platforms. Secondary efforts focused on testing the concept and design, and preliminary performance reviews. Follow-on evaluations will center on performance criteria and safety evaluations.

BACKGROUND

As the U.S. Military emerges as a global police force freeing individuals from civil unrest, offering famine relief, and keeping warring factions apart, the need for less lethal technology becomes more apparent. Not to be overlooked in this area is the need to keep combatants at a safe stand-off distance, as generally the closer a combatant becomes, the greater the threat they pose. The ability to deal with unarmed combatants at an extended range, greater than 30 meters, in a less lethal manner has become a top priority to the U.S. Military.

As unarmed combatants congregate, the level of threat they pose to "peace-keepers" steadily rises. The ability to disperse crowds in a less lethal manner as they gather or loiter has become a problem for U.S. forces and became apparent in Haiti, Somalia, and more recently Bosnia. Less lethal technology is currently available to deal with these combatants in close proximity, i.e. 3 to 30 meters. This technology includes oleoresin capsicum riot agent (pepper spray), specialty impact munitions (foam and wood batons, bean bags, and rubber pellets), noise or diversionary devices, and rubber pellet grenades. However, because of the inability to maintain a "safe zone", the ability to defuse a potential scenario in which the only alternative becomes lethal force, has not been readily available.

A less lethal stingball grenade that will provide stand-off capabilities out to 100 meters or more in a 66mm configuration would have multiple benefits. First and foremost, this system is compatible with existing United States and United Kingdom 66 mm grenade launchers. The benefits of this system is that these launchers are currently mounted on almost every track and a majority of the wheeled vehicles utilized by the U.S. Army. However, the only available munition has been a CS riot agent or smoke grenade. Concerns have also been raised about the use of chemical agent for crowd control in light of chemical treaty bans.

A 66 mm stingball grenade and or sound diversionary device will fill this extended range void, while not requiring any new equipment or weapon platforms. The benefit is not just in the savings in acquisition of new equipment and launch platforms, but also in soldier training, materials maintenance, and munitions deployment. Because the munitions deploy similar to the current 66mm munitions, there is no increased cognitive skills required for the soldier.

OBJECTIVE

The primary purpose of this effort was to determine the feasibility of producing an extended range less lethal munition. The intent was to develop a munition that would not require any new weapon platform or modification of existing equipment. The effort would focus on the 66mm launch systems, the LVOSS and L8 smoke launcher. In addition, the munition would be designed without the deployment of chemical agent as the primary method to disperse the crowd.

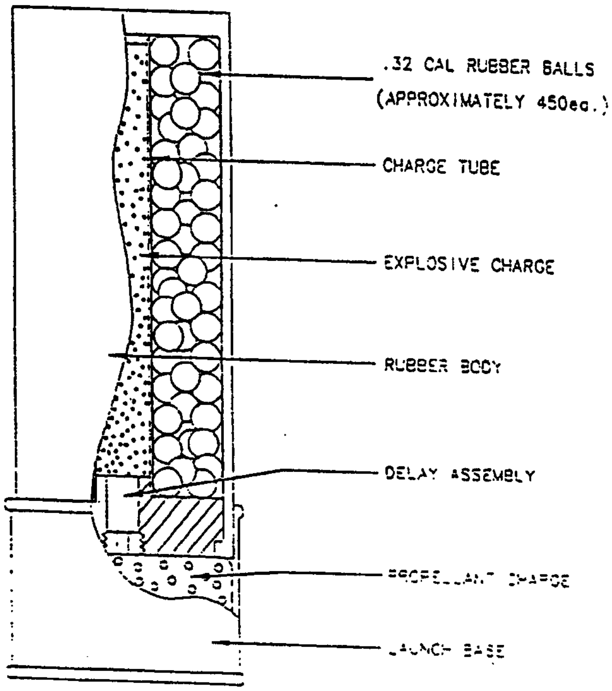
Once the above requirements were met, the concept and design was tested. Upon completion, the munition will be subjected to performance reviews and safety evaluations.

STUDY DESIGN

Concept and Design Phase

The materials that are currently used in the L8 smoke grenade were obtained. The components were examined and the engineering design and feasibility was evaluated. Explosive component combinations were researched. Two standard configurations were chosen; black powder and a flash composition (magnesium, aluminum powder, and potassium perchlorate). The black powder was tested in a 15 gram charge and was chosen based on its relatively stable handling condition. The flash mixture was tested in four charge volumes; 8, 10, 12, and 15 grams.

Static tests were conducted with the explosive charges to demonstrate the feasibility. The munitions were placed in a launch vice and secured. Once fixed in place, the munitions were ignited using standard quick match. The tests were recorded with a standard Hi 8mm video camera placed behind an impact shield at twenty feet. The explosive testing sequence began with black powder and culminated with the 15 gram flash composition. After completion of the static tests, the munitions were launched without an explosive charge, using a M257 4-tube launcher to determine the launch distances. The launcher was mounted to a metal table stand approximately 30 inches high. The launch tubes were fixed at 20 degrees. The launcher was connected to a 12 volt power supply and wired with a launch switch. The standard L8 smoke launch base and delay was used. Upon completion of the inert launches, the munitions were loaded with the explosive charges and launched as described above.



Two projectile payloads were selected for dispersion testing. Seventy-five durometer "A" scale rubber balls in 0.32 caliber and 0.60 caliber were added to the rubber body of the munitions. Approximately 450 of the 0.32 caliber balls fit into the rubber body, compared to about 50 for the 0.60 caliber balls. The munitions were secured and ignited with quick match. All munitions were static fired using the above charge configurations and test sequence. The 0.32 caliber balls were tested first, followed by the 0.60 caliber balls.

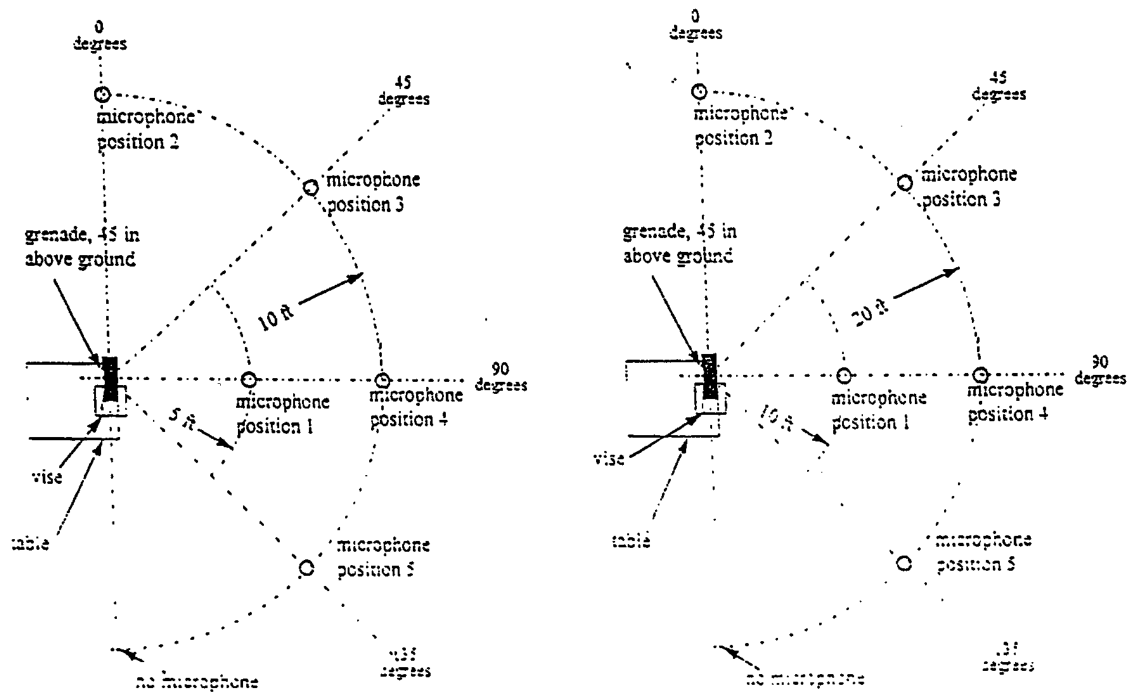
Launch tests were conducted with both calibers of rubber balls with no explosive charge, to determine the achievable launch distance with the increased payload weight. Upon completion of the inert launches, munitions with the explosive charge configurations were launched. The munitions were deployed in the same manner as stated above. The test firings were recorded with the Hi 8mm video camera.

Performance Review

An attempt was made to record projectile velocities using a modified static ignition stand. The munitions were placed within a deflection housing located 36 inches from an Oehler Model 35P chronograph. All charge and projectile variations were tested. A demonstration was conducted at Defense Technology Corporation in Casper, Wyoming, in order to carry out performance testing and to conduct a mid-point review. Static and launch firings were done for each charge configuration and projectile size. High speed and standard video recordings were taken of the static and launch scenarios. Grids were constructed against a rigid wall behind the static launch vice in an attempt to determine projectile velocities using high speed video. Linear distances were recorded for each munition launch from the point of detonation.

Information was obtained from previous impact research studies in which 0.32 caliber and 0.60 caliber balls were tested. Correlations and comparisons were made, where possible, to this blunt injury data which includes modeling clay, gelatin, and a biomechanical surrogate; 3-Rib Chest Structure. A review of other safety and performance data was conducted on similar products that have been tested.

Noise level testing was conducted in accordance with the general requirements of MIL-STD-1474. Five B&K type 2231 sound level meters with type 4136 1/4 inch microphones were arranged in a semi-circular arc, as shown in the below figure. Tests were conducted at five and ten feet, and ten and twenty feet.

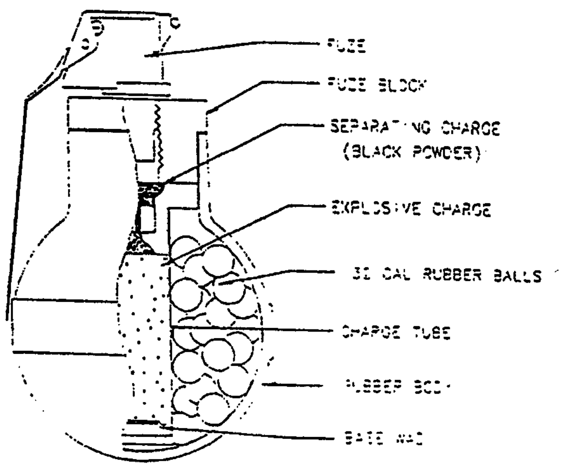


RESULTS/DISCUSSION

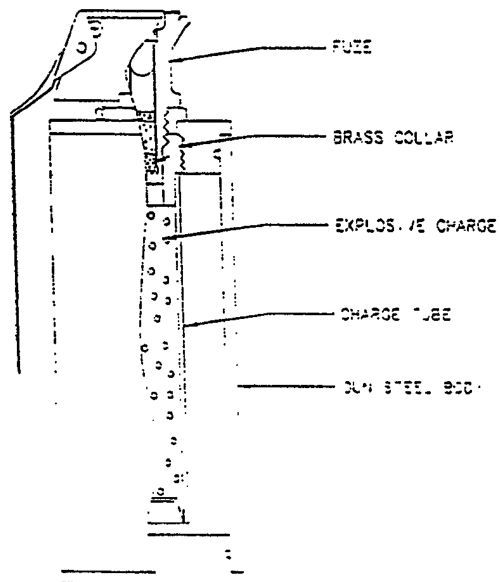
Concept and Design Phase

After obtaining the L8 components, it was determined that a stingball was feasible using the existing components. The decision to proceed was based on previous experience and manufacturing practices that are used in the production of the Defense Technology #15 Stinger Grenade and the #25DD (Distraction Device). Even though both munitions utilize a flash composition of different charges, a black powder charge was used based on its' relatively stable handling condition. This provided a quick demonstration of the feasibility without having to endure the rigors of extensive loading and handling concerns.

#15 STINGER



#25 D.D.



The static tests proved that the materials used for the L8 would be sufficient to test and demonstrate the concept and design. As expected, the black powder charge produced a much slower and lower sound report than all of the flash charges. The flash powder produced a much more brilliant and thunderous burst. Upon examination, the black powder appeared to only split the rubber bodies or remain mostly intact with only a small section removed, whereas the flash charges seemed to shred the rubber bodies into pieces no larger than a quarter. A similar observation was made in reference to the charge tubes, where it was not uncommon to find larger pieces with the black powder and no sign of the tubes when the flash powder was used. However, as the performance criteria for this munition have not been completely established, the black powder was not eliminated from further testing.

The launch test demonstrated a linear launch distance of approximately 60 to 70 meters with no explosive charge. Because the standard propellant charge and delay for the L8 was used, once the explosive charge was added, the munition detonated approximately one and a half to two seconds after launch, at a distance of roughly 30-40 meters. The munitions produced an aerial burst at a height of 7 to 12 meters. This demonstrated that an aerial distraction device is achievable using the existing weapon platform and the standard material for the L8.

Once the function of the device was tested and proven, the balls were added to determine if the material that the rubber body is molded with was acceptable, and provided an adequate dispersion pattern. The black powder charge showed similar rupturing of the rubber body when detonated, as recorded earlier, which did not appear to consistently distribute the balls evenly. However, the flash charges all appeared to distribute the balls more evenly, with the larger charges seeming to scatter the best. This seemed to hold true with both calibers of balls, with the only exception being that the smaller caliber of balls obviously allowed for a greater distribution and significantly more area of coverage, i.e. 50 vs. 450 projectiles.

With the addition of the rubber balls, the launch distance decreased slightly to around 50 to 60 meters. However, the aerial detonation distance and height remained roughly the same at 30 to 35 meters and 7 to 12 meters high. Once again, the flash composition produced a markedly greater burst and distribution of the balls with a significant increase in coverage area with the smaller caliber size. The munitions seemed to consistently distribute the rubber ball projectiles, however, the launch base was more unpredictable in where it landed, with some traveling as far as 20 to 25 meters from the point of detonation.

Performance Review

The attempt to record velocities of the rubber balls with a chronograph was unsuccessful, as the concussion from the detonation prevented proper readings. Furthermore, the high speed footage of the static tests obtained at the mid-point review also had limitations. The 15 gram flash charge produced a burst that prevented tracking of the projectiles. However, velocities of the projectiles were estimated for a 12 gram flash charge to be 750 feet per second. This was determined by tracking the projectile over three feet which took 0.004 seconds. Unfortunately, only one velocity determination was calculated.

The sound report generated during the noise level testing produced an average rating of 173.7 decibels at 10 feet. This level is consistent with current diversionary and distraction devices used by the law enforcement community. Dispersion patterns for the rubber projectiles are scheduled to be conducted. A test arena will be constructed around a static launch stand to measure the dispersion pattern and distribution of rubber balls upon detonation.

Safety review

An Interim Hazard Classification (IHC) has been obtained, which will allow for shipment of these munitions until December 4, 1998. The proper shipping classifications are as follows:

DOD Hazard Class/Div/SCG: 1.3G
DOT Hazard Class: 1.3G
DOT Label: Explosive 1.3G
UN Serial Number: 0318
DOT/UN Proper Shipping Name: Grenades, Practice
DOT Container Marking: Grenades, Practice
UN 0318
NSN: 1330-00-D01-0492
Net Explosive Weight: 0.0386 lbs (0.0175 kg)
Net Propellant/Pyrotechnic Weight: 0.0
Net Explosive Weight for QD Determination: 0.0386 lbs (0.0175 kg)

While safety evaluations of these specific munitions have not been carried out, information is available on similar products that may provide valuable insight. Defense Technology has conducted research on some of their products that either utilize the same projectiles (0.32 and 0.60 caliber rubber balls) or the same explosive composition (flash powder). Blunt impact data is available for both calibers of rubber balls by various evaluation methods. These projectiles have been impacted into modeling clay, gelatin, polystyrene foam, and a biomechanical surrogate 3-Rib Structure developed by General Motors.

Impact measurements have been taken for these projectiles at velocities ranging from 51 to 1150 feet per second for the smaller balls and 200 to 1200 feet per second for the larger balls. All evaluations appeared to support the use of these projectiles as a less lethal alternative. However, at high velocities or close distance, they may be lethal if impacted into the head and or ocular region. This also raises the question about what is the level of acceptability. The intent of less lethal is that under normal conditions and use, a lethal outcome would be a rare and unexpected result. The loss of an eye, for instance, would be a very unfortunate occurrence, however, it would none the less be considered a less lethal application. For this reason, a clear understanding of acceptability needs to be defined.

Further research has been conducted on the performance of the flash composition as it relates to the sound report and flash generation. The 15 gram flash mixture is used as the explosive charge for the #25DD produced by Defense Technology. Independent testing was conducted during the design of this product that determined that this formulation and charge generated a sound report of 175 dB at five feet, along with a 2.4 million candela flash rating, which is consistent with the sound levels recorded for the 66mm stingball.

Effectiveness/Desired effect

These projectiles have been used extensively over the last five to ten years in less lethal applications by the law enforcement community. They have been deployed in a variety of methods ranging from 37mm and 40mm munitions, 12 gauge shot shells, and hand-held stingball grenades. These munitions have been deployed as method to deal with non-compliant and or violent individuals by routing or moving them, thus promoting areal denial. The primary objective of these munitions is not to incapacitate these individuals, but rather deter them from unwanted actions or prevent access to certain areas.

CONCLUSION

The research and testing was successful in that the concept and design modification was proven to be feasible, which produced a viable solution to fill the void as an extended range less lethal standoff. The 66 mm Stingball is unique in that it combines a mechanism to disperse rubber balls that cause a stinging sensation upon impact, with that of a sound or diversionary device. The intent is not to incapacitate the individuals but rather rout or move them, thereby maintaining a safe stand-off distance. Those individuals not impacted by the rubber balls will still be effected by the sound report of the device. This combines the effect of a physiological along with a psychological response. This combined effect is a useful tool in dispersing crowds in a less lethal manner, while providing the stand-off needed to ensure the safety of the soldiers, and in doings so, the safety of the combatants as well.

RECOMMENDATIONS/ FOLLOW-ON

Effectiveness/Desired effect

One of the most significant areas of review should focus on establishing the desired effect of the munition. Is the intent merely area denial as has been assumed, or incapacitation? Without this criteria, the effectiveness and safety review can not be completed. Areas of focus should include a level of acceptability in relationship to injury and lethality, and also performance.

Performance Review

When evaluating the performance of these munitions, several variations and modifications have been tested. By modifying the delay and or the propellant charge these munitions can be fired at greater or lesser distances, and may also be aerially detonated or provide ground bursts. Obviously, ground bursts would have a greater possibility of causing injury by landing on or in close proximity to an individual or materials that may cause greater secondary effects such as flammables and combustibles. As has been stated in this report, there were two variations of balls that were used in this study. Benefits and limitations should be associated with the use of each. Lastly, while the intent of this project was not to rely on the use of chemical munitions, that option is readily available, should the focus change.

Safety review

As with most endeavors, one of the most critical evaluations is that of safety. Levels need to be established for the soldier, as well as that of the combatant. As mentioned, a level of acceptability of injury or lethality needs to be determined in order to adequately establish a safety rating. Further considerations should be given to expanding upon the IHC's that have been received, and focusing on long term storage and transportation.